The Evolution of MoPeD: Progress & Opportunities

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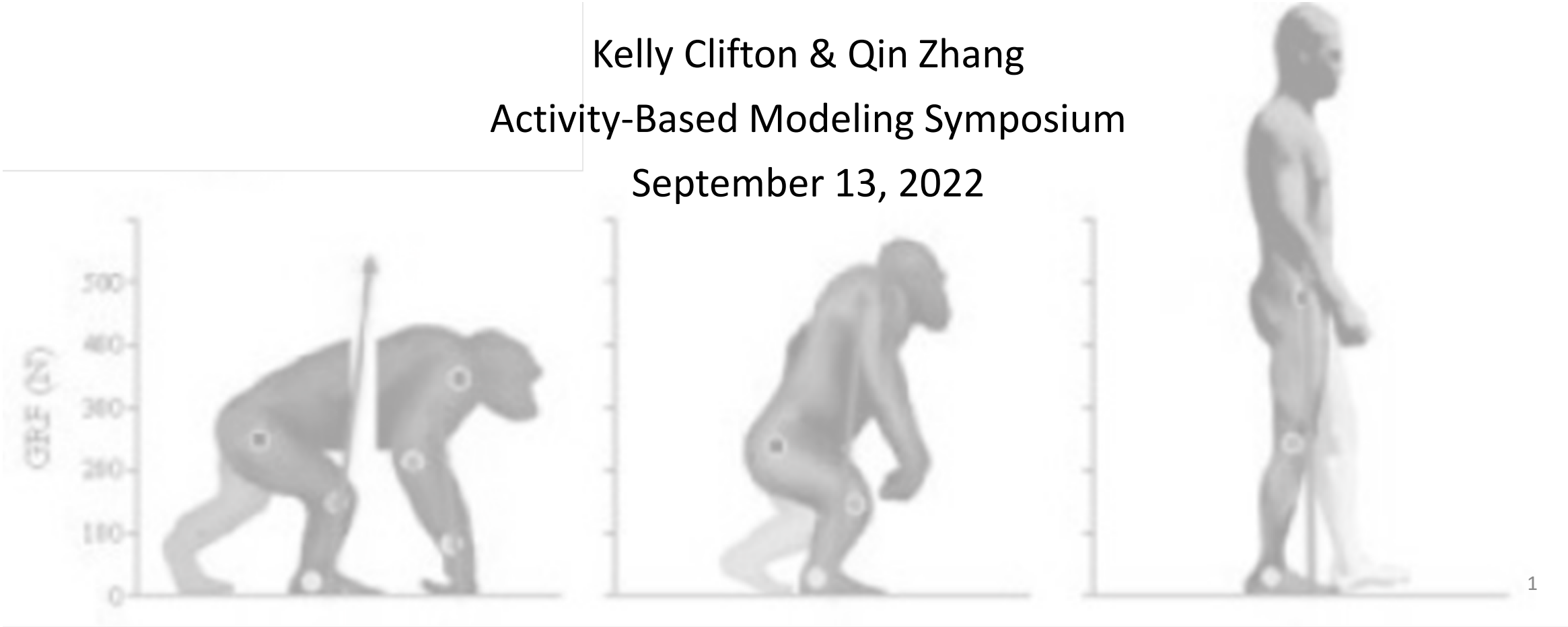
Activity-Based Modeling Symposium

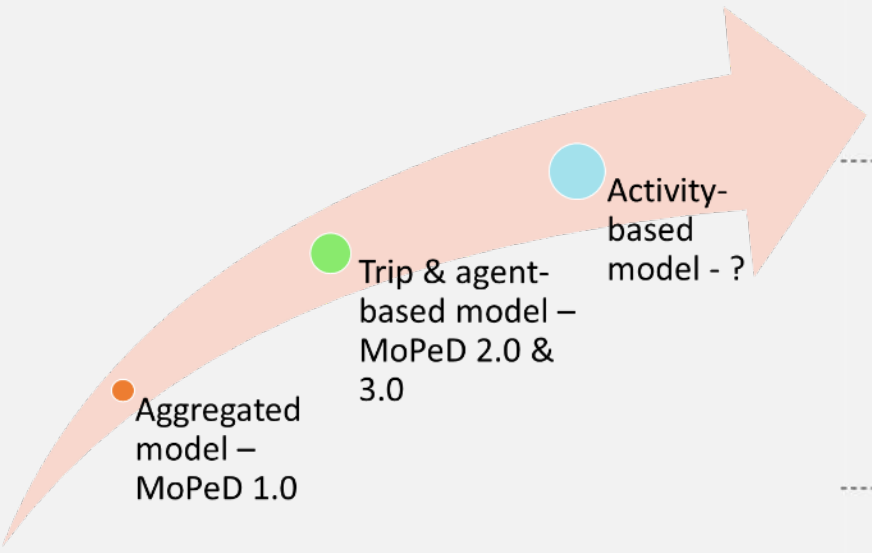
September 13, 2022

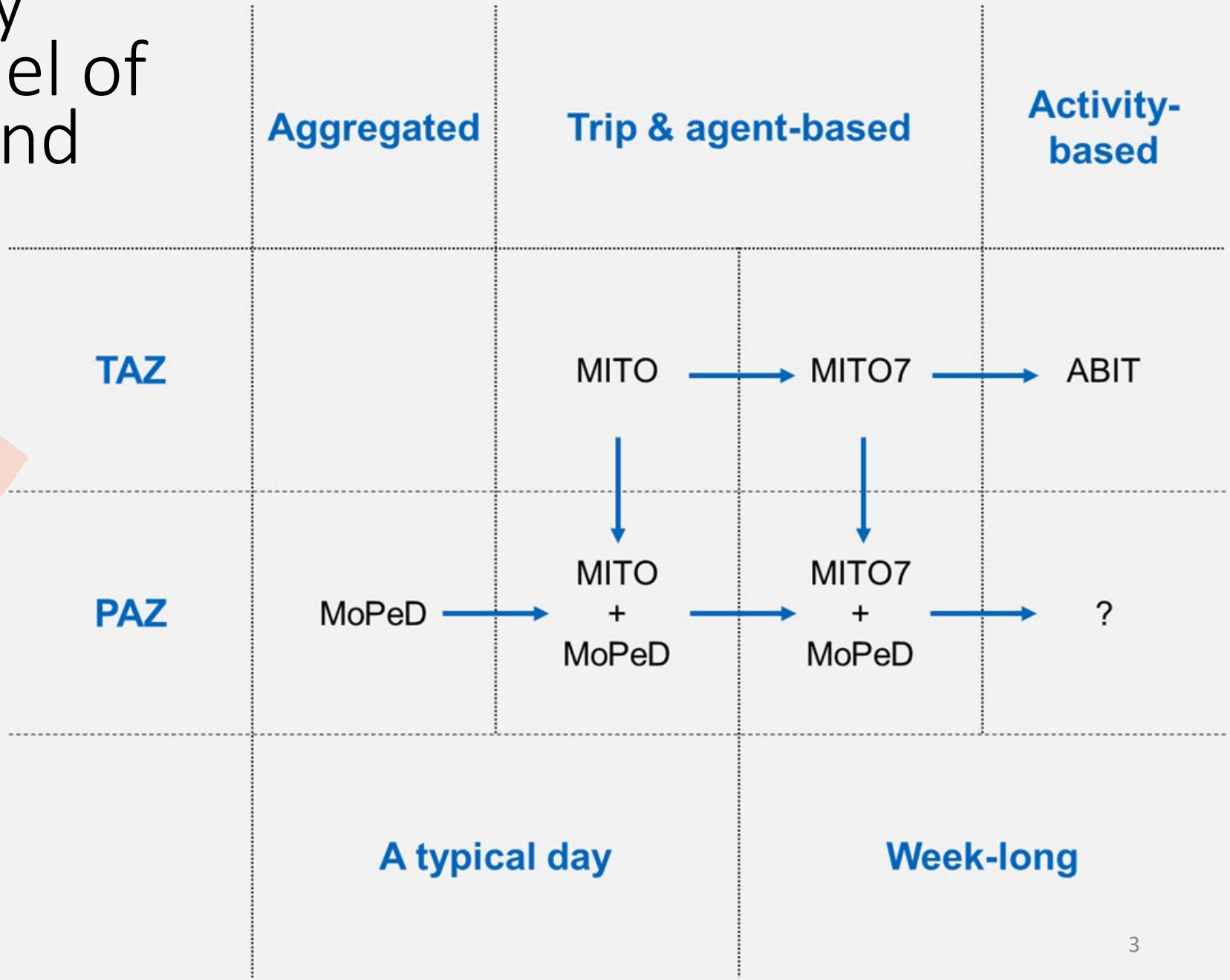


“Perhaps walking is best imagined as an 'indicator species,' to use an ecologist's term. An indicator species signifies the health of an ecosystem, and its endangerment or diminishment can be an early warning sign of systemic trouble.”

— Rebecca Solnit, *Wanderlust: A History of Walking*

“The Evolutionary Path” of the Model of Pedestrian Demand (MoPeD)

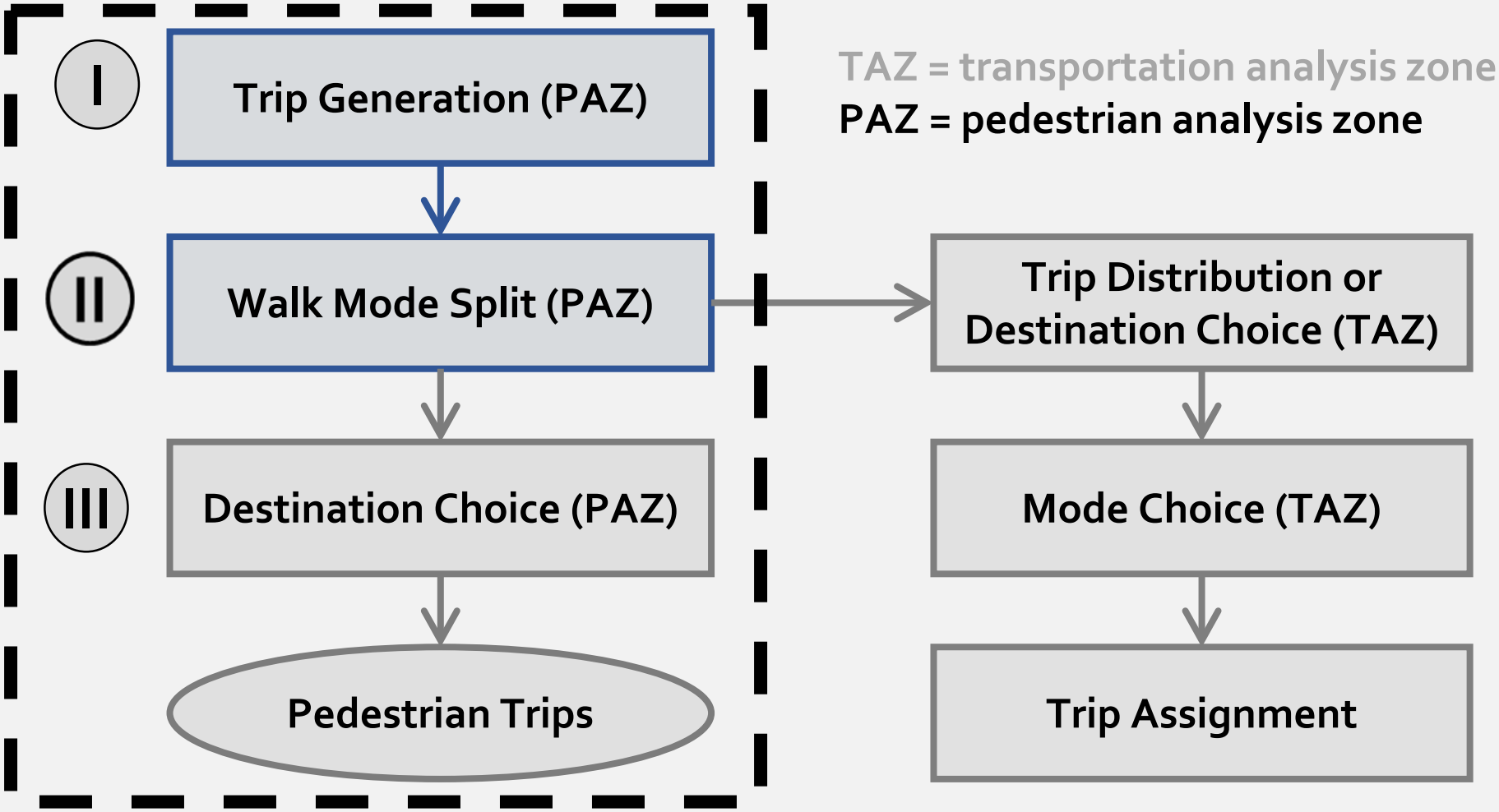




MoPeD 1.0

Aggregate Model for Integration into Portland Metro's Trip Model

MoPeD 1.0 Framework

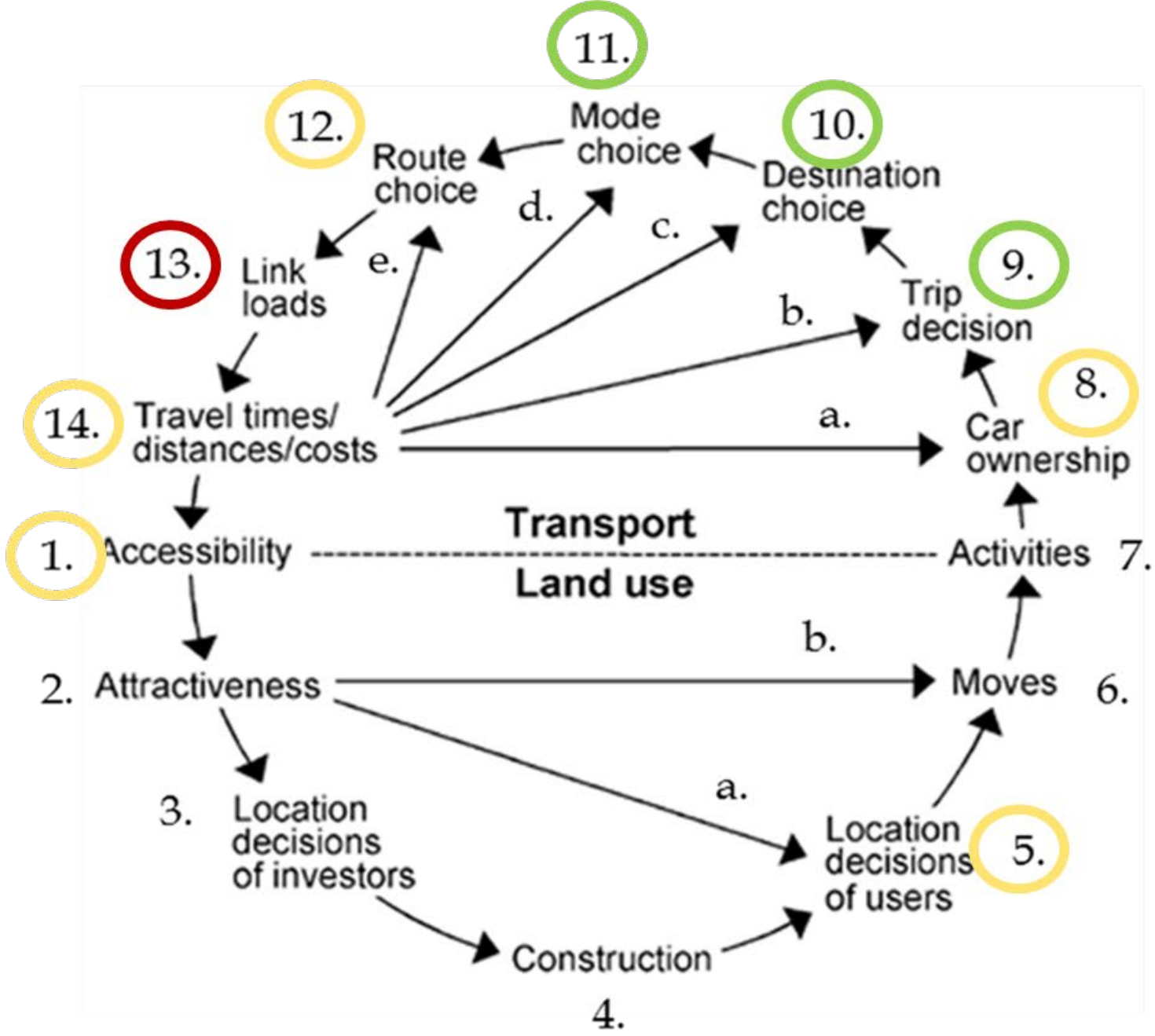


Contributions

- Nests within current structure but can be used alone
- Pedestrian scale analysis (PAZs) – 80mx80m grid
- Pedestrian-relevant built environment variables (PIE)
- Pedestrian destination choice
- Highlights policy relevant variables: distance, size,

  pedestrian supports & barriers

2016 Symposium for the Integration of Land-Use & Transport Models



Ready

Challenging

Most Challenging

Adapted from: Wegener and Fürst, 1999

MoPeD 2.0

MITO/MoPeD Integration

Developed for Munich

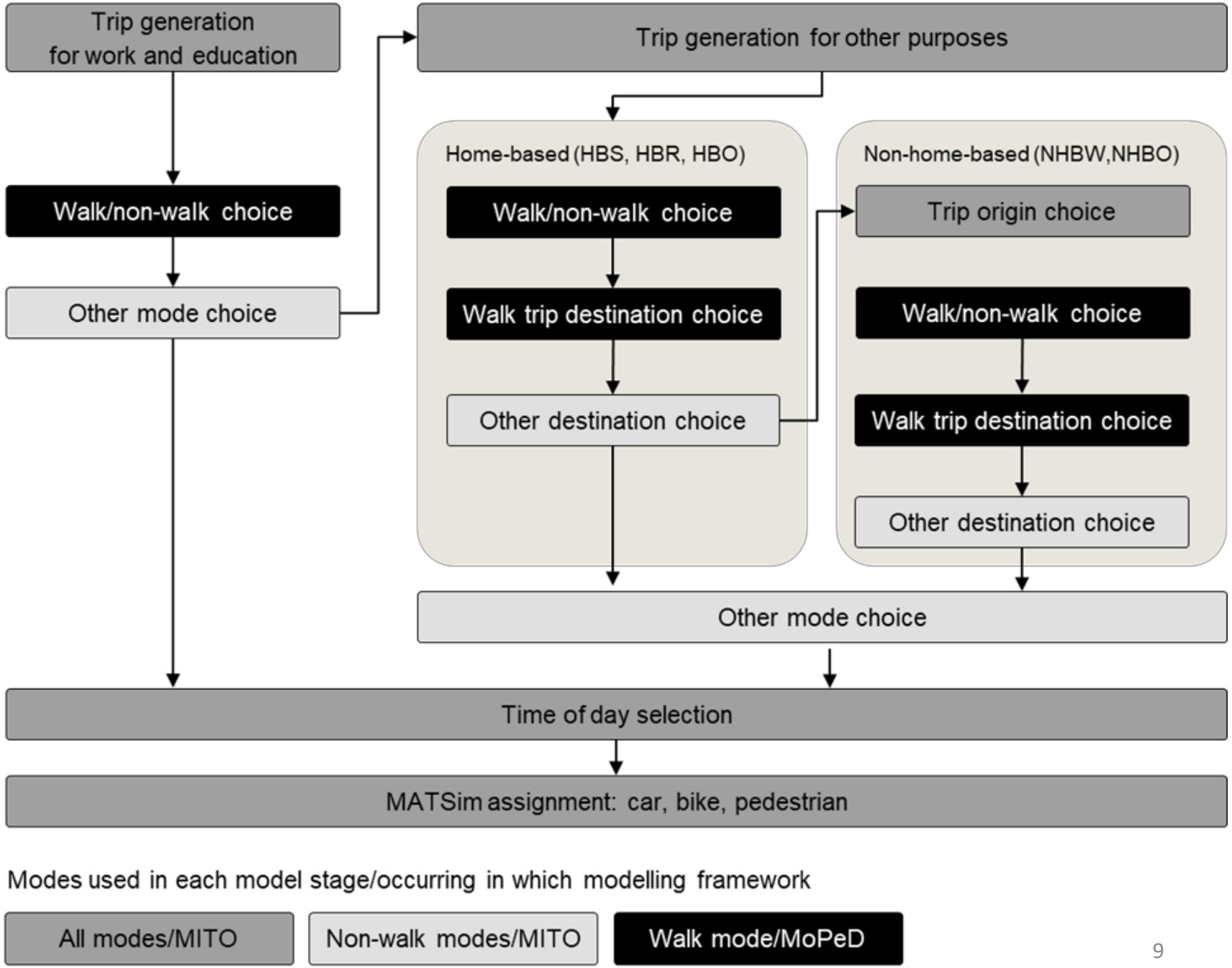
MoPeD 2.0 - The Hybrid Model

Benefits from MoPeD 2.0:

- Fine spatial resolution
- Pedestrian built environment
- Pedestrian behavior models

Benefits from MITO:

- Agent-based environment
- Behavior models of other modes



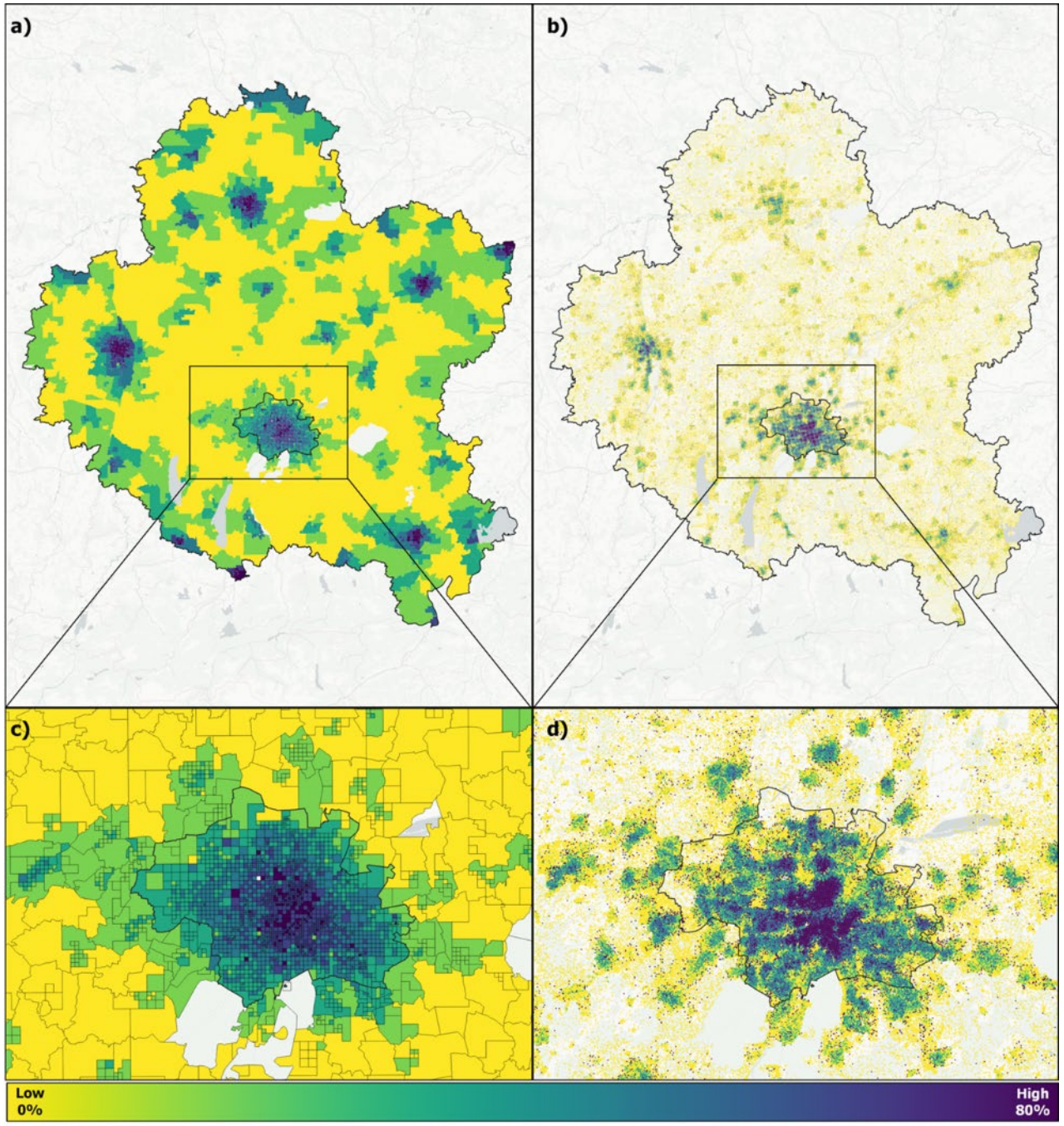
MoPeD 1.0 → MoPeD 2.0

	MoPeD 1.0	MoPeD 2.0
Model efficiency	Programed in **R** with slow run times and could only run for a small area at a time.	Program the models in **Java**. It is operational for the entire Portland/Munich region with a **runtime of a few minutes.**
Pedestrian built environment measurement	The **Pedestrian Index of the Environment** called PIE was **less transferable** to other applications.	**New pedestrian accessibility measurement**: number of jobs and population within an 800-meter network distance buffer for the pedestrian catchment area.
Pedestrian destination choice model	The destination choice model estimation used a random sampling method to define the choice set of 10 SuperPAZs, which limited the performance of the model.	Develop a **two-stage destination choice model** using full choice sets within a 3-mile radius.
Pedestrian assignment	**No** pedestrian route assignment.	Pedestrian route choice is implemented using **MATSim.**

MoPeD 2.0: Munich application

Improvements over Munich model:

- More precise spatial distribution of walk trips
- Better capture of short-distance trips
- Pedestrian flows on network links



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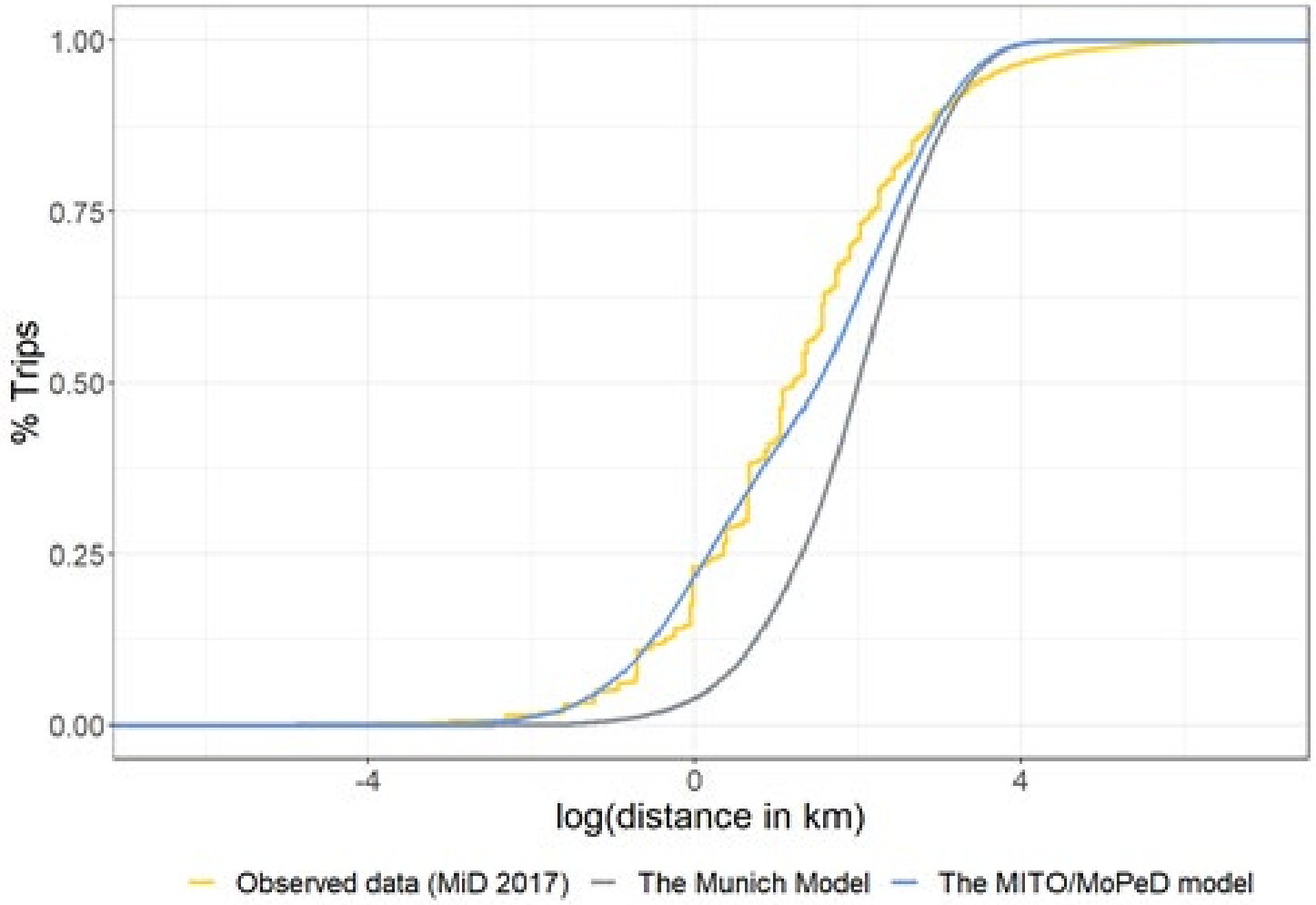

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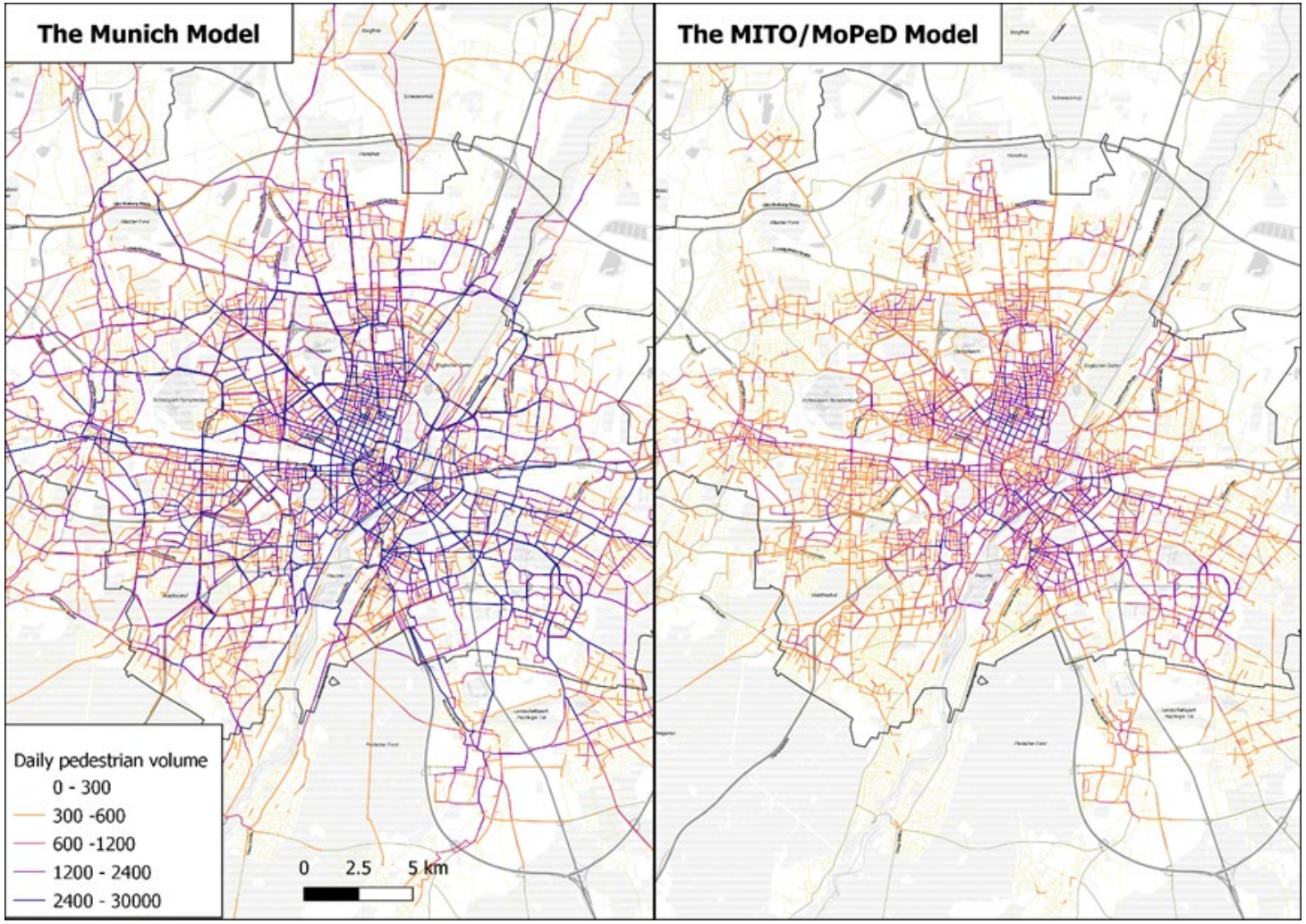


MoPeD 3.0

MITO7/MoPeD
Developed for Munich

MITO7 + MoPeD (7-day Model)

Key Innovation: Linking to Health

- Discretionary trip generation depends on mandatory trip generation

  Plausible behavioural responses to changes to commuting
- Model 7 days of travel

  More representative of habitual behaviour
- A **mode set** model limits the modes available to each agent

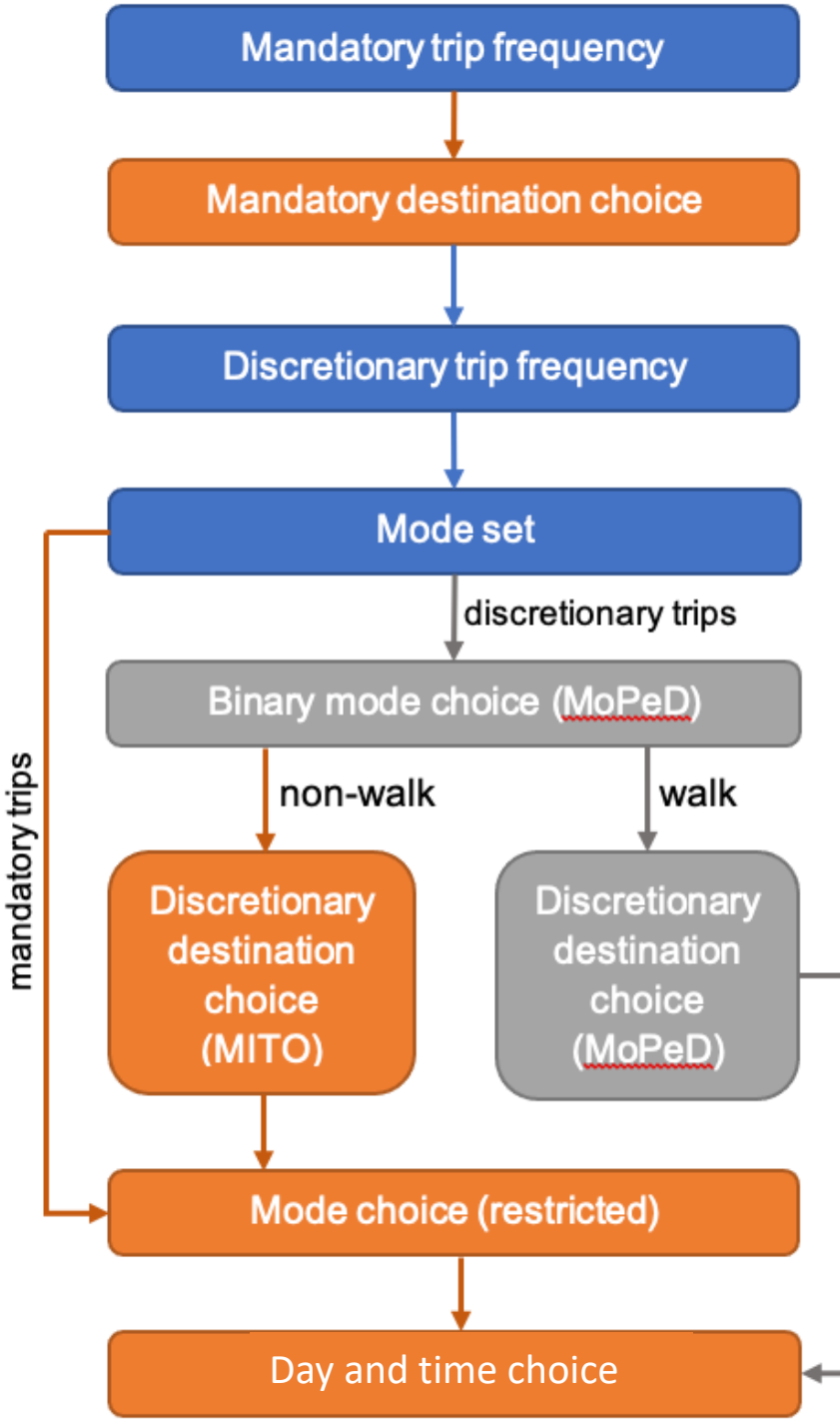
  This model is based on Ton (2019)

  More realistic mode choice variation over the week
- The MoPeD pedestrian model is used for walk trips

  This model is based on Zhang et al. (2021)

  More realistic distribution of walk distances

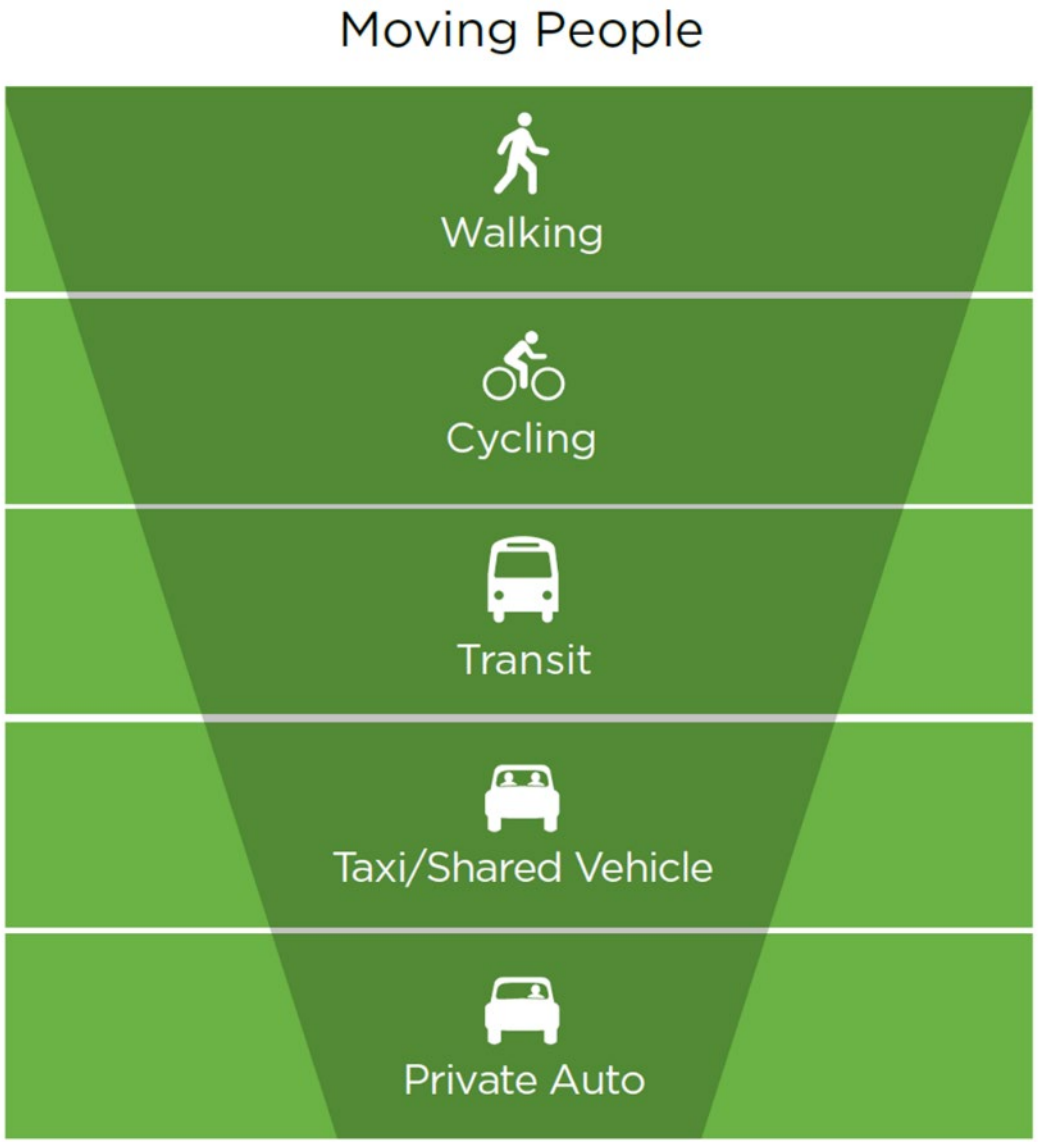
  Built environment predictors relevant to travel behaviour

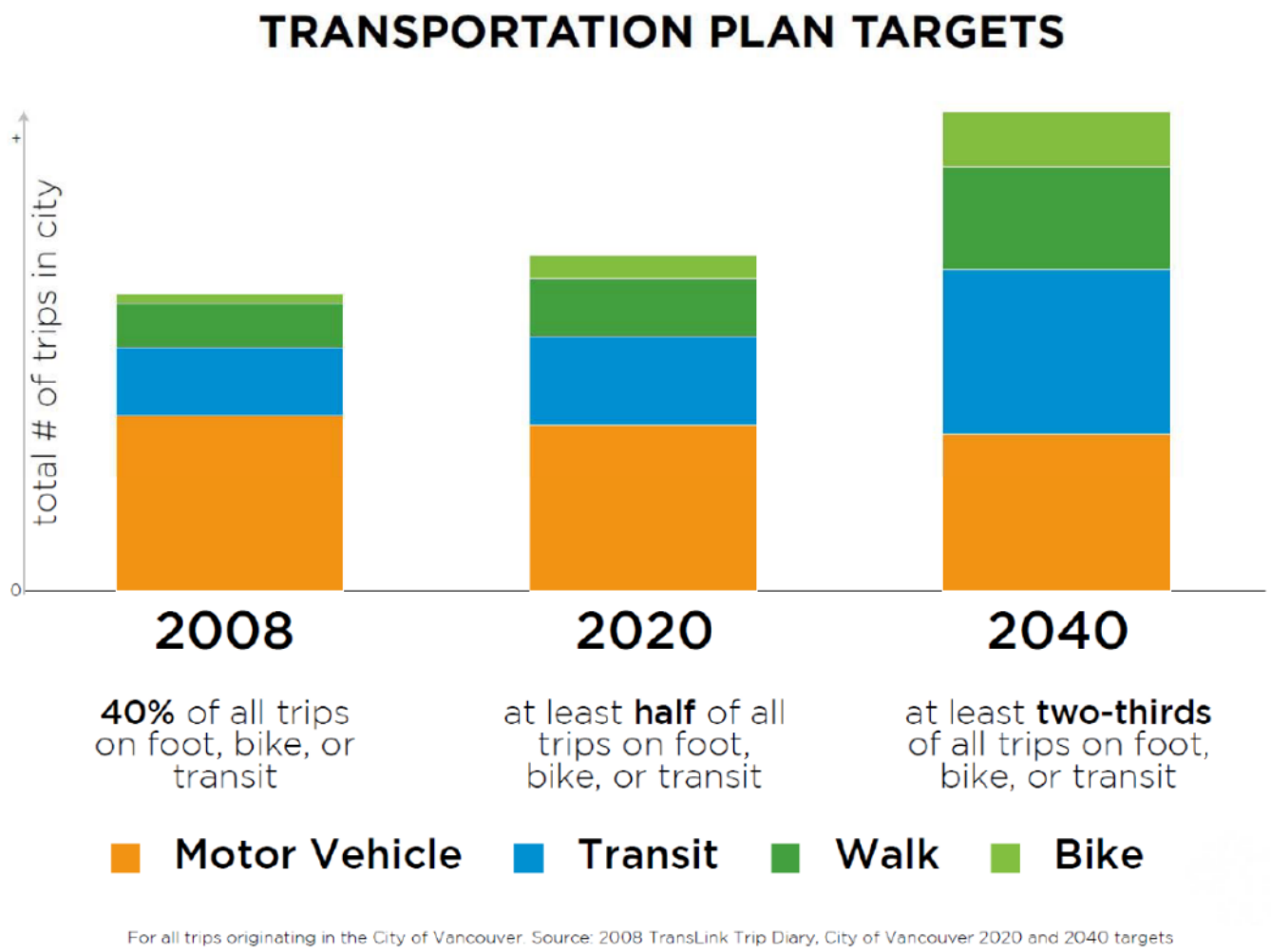


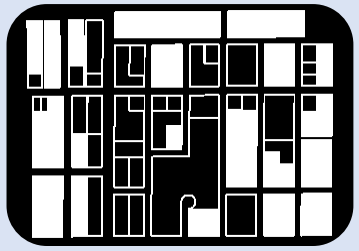


MoPeD 4.0 – Opportunities

Manchester – Munich - Vancouver

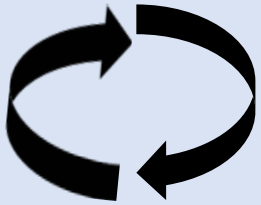

Moving People
Walking
Cycling
Transit
Taxi/Shared Vehicle
Private Auto


TRANSPORTATION PLAN TARGETS
total # of trips in city
+
0
2008
2020
2040
40% of all trips on foot, bike, or transit
at least half of all trips on foot, bike, or transit
at least two-thirds of all trips on foot, bike, or transit
Motor Vehicle
Transit
Walk
Bike
For all trips originating in the City of Vancouver. Source: 2008 TransLink Trip Diary, City of Vancouver 2020 and 2040 targets



Built environment

thresholds, heterogeneity, & nonlinearities



Mode choice feedbacks

trip generation

future mode

Mind-Body-Environment

cognitive load

health outcomes

Decision sequencing

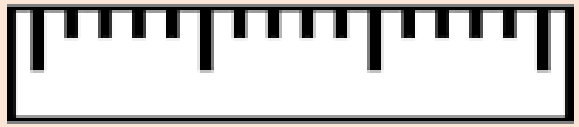
activity, mode, destination;
activity, destination, mode;
mode, activity, destination

Willingness to walk

energy expenditure

positive utility of travel

diminishing returns



Path/route choice considerations

energy expenditure

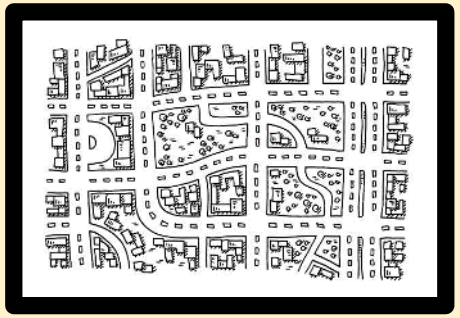
noise, comfort, safety

Access/Egress

Parking/TNC/Transit

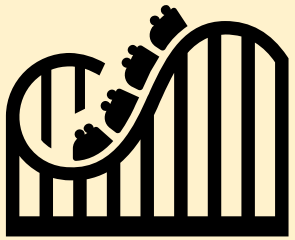
Network Development

Attributes salient to behavior
Informal links and trails
Indoor



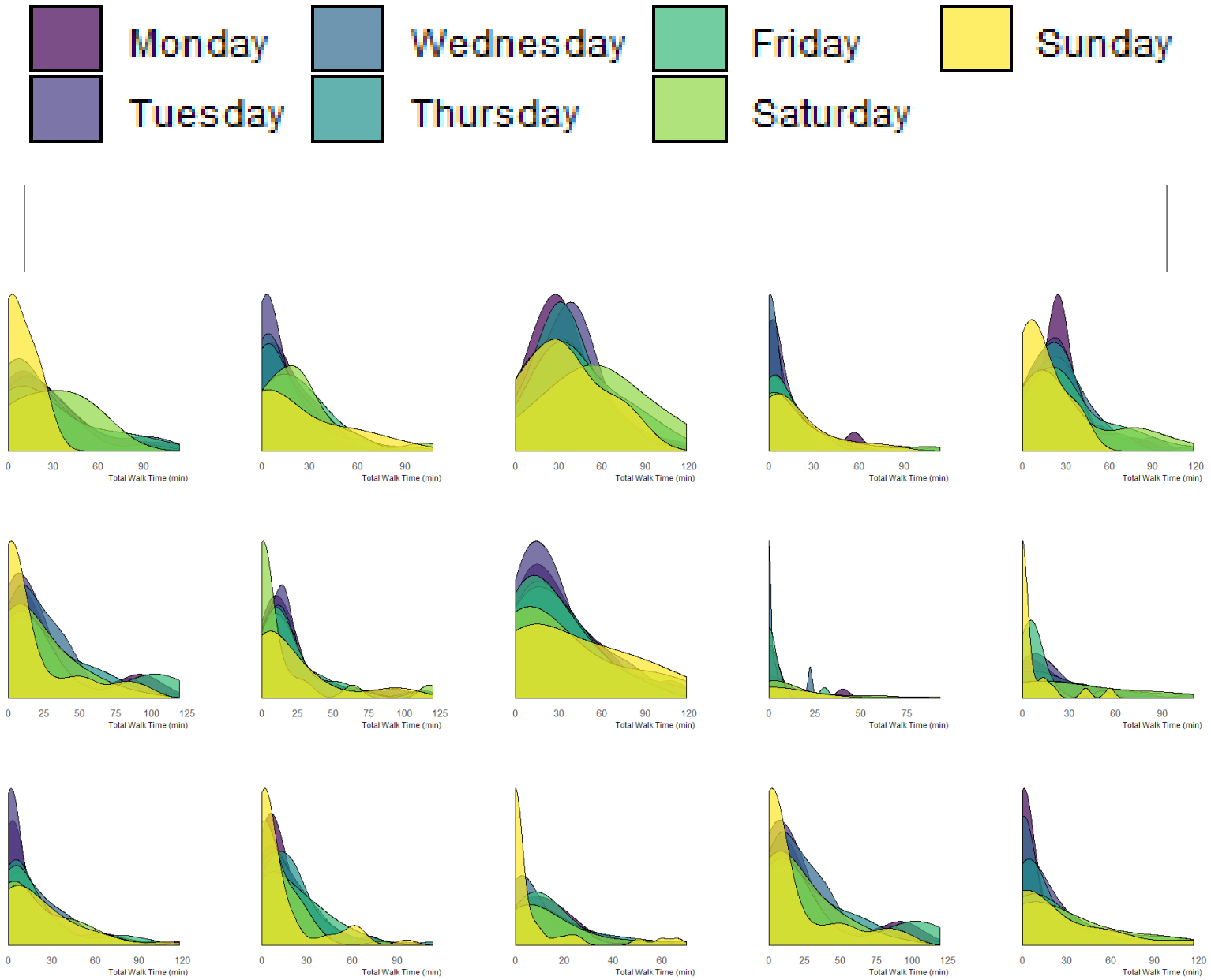
Behavioral variability

Budgets: Activity, Travel, Physical Activity
Response to the built environment
Weather
Economy



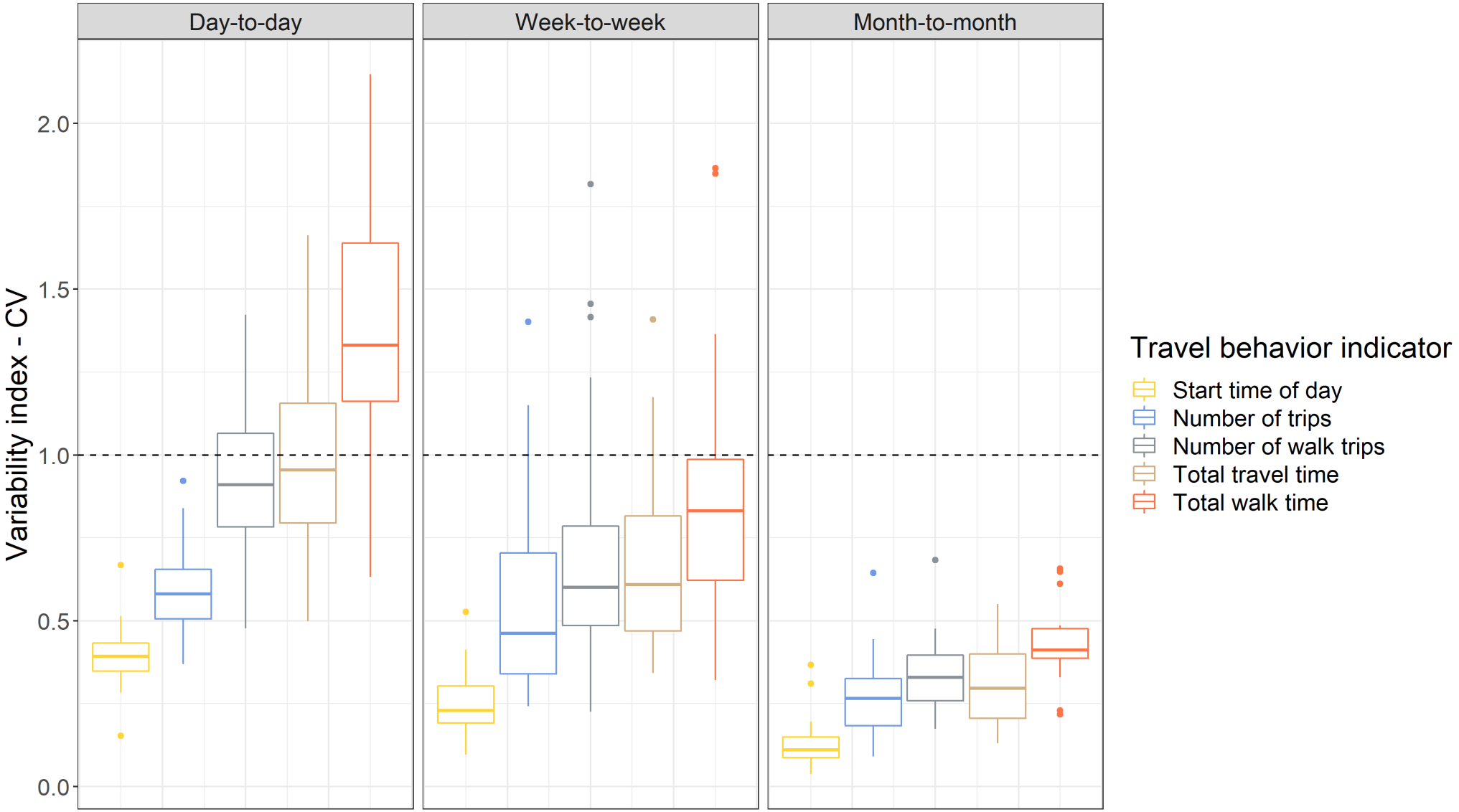
Longitudinal Analysis – Google Timeline

Individual Travel “Cardiogram”
(daily metrics for one year)



Weekday Walk Time Variability (N=15)

Individuals have a *great deal of day-to-day variability*. *Week-to-week travel behaviors* have relatively *low dispersion*, while people tend to have *periodical behavior at a monthly scale*.



Intrapersonal variability index (CV) of different travel behavior indicators across different temporal scales

Conclusions

- Progress in development
- Slower to be adopted by agencies
- Increasing interest in health and equity outcomes
- Fewer behavioral data challenges
- Need better network information at finer resolution